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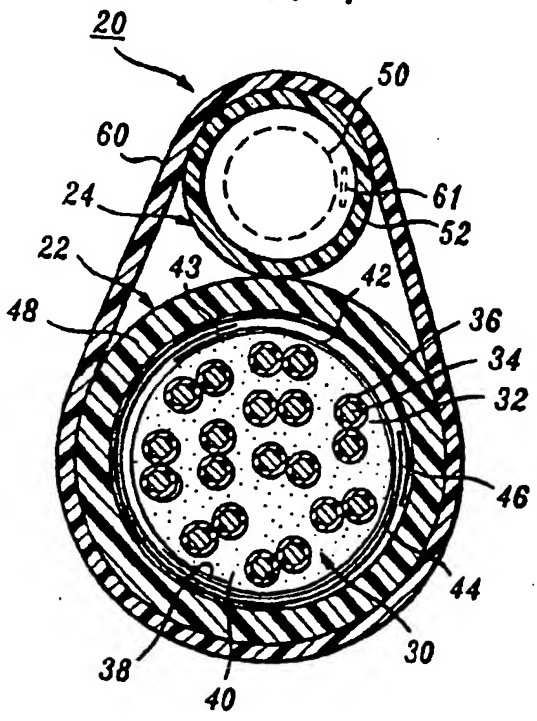
(54) Hybrid communications cable for enhancement of transmission capability.

(57) A hybrid cable (20) includes a first transmission portion such as a metallic conductor portion (22) and a second transmission portion such as an optical fiber portion (24). The metallic conductor portion includes a core which includes twisted pairs of metallic conductors enclosed in a plastic core wrap, a shielding system and a plastic jacket (48). A longitudinally extending duct (52) is disposed in engagement with an outer surface of the plastic jacket of the metallic conductor portion. An outer plastic jacket (60) is disposed about the duct and the metallic conductor portion. An optical fiber cable (50) or optical fibers (51, 51) may be caused to become disposed initially in the duct or when the use of fibers becomes economically justified.

FIG. 1



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Technical Field

This invention relates to a hybrid communications cable for enhancement of transmission capability.

Background of the Invention

Operating telephone companies have expressed a desire to install cables which include metallic conductors as well as optical fiber capability. Notwithstanding the rapidly escalating use of optical fiber, there remains a need for metallic conductors such as copper conductors. Furthermore, there may be a need for both optical fiber and metallic conductors at the same end use point. One such application may be at office workstations in a computerized facility. Another may be to provide additional transmission media for metallic circuitry not yet fully utilized.

Such a need translates into a need of a hybrid cable which is intended to refer to a cable which offers the capability for both optical fiber and metallic transmission. A course of action of early placement of optical fiber capability along with metallic conductors in aerial or buried installations to customers' premises will facilitate the later transition from a metallic to an optical fiber operating system.

The sought-after cable should have desired properties. For example, it should have a relatively high tensile and compressive loading capability, a relatively low minimum bend radius, stiffness in order to insure that the optical fiber unit remains as straight as possible to minimize bend losses, an operating temperature range of about -40 ° to +160 ° F and low cost. The cable should be able to withstand repeated impact during installation. Also, the structure must not be affected adversely by cable filling compounds. The cable must be water-resistant to prevent degradation of transmission or damage due to water-induced crack propagation or freezing. In those instances when it will connect to customers' premises, the cable must be capable of being made flame , retardant. Also, the sought after cable should be relatively easy to manufacture and to connectorize despite the capability for different kinds of transmission media.

Hybrid cables are known to the prior art. For example, U.S. Pat. No. 4,852-965 describes a hybrid cable which includes a reinforced optical fiber unit. The unit includes an optical fiber or fibers enclosed by at least three impeegnated fiberglass memb rs and a jacket. The unit is included along with metallic conductors in a core tube enclosed in a plastic jacket.

Also important is access to the transmission media. In some prior art composite cabl s, optical fibers are disposed in a c ntral portion th reof with copper conductors arranged thereabout. Se , for example, U.S. 4,552,432. As a result, in order to access the optical fiber, a craftsperson needs to work through the copper conductors. Further, from a manufacturing standpoint, sometime conflicting sheath design constraints for copper and fiber t chnologies as well as the configuration required for various fiber and/or conductor counts increases greatly the cable complexity and cost.

In the alternative, an initially installed cable may include the metallic transmission media and a duct in which optical fibers are to be installed at a future date. When a duct for receiving optical fiber in the future is installed, the major portion of the construction is accomplished initially. At some future date, optical fiber is caused to be moved into the existing duct with minimum further construction activity.

Seemingly, the prior art is devoid of such a cable which provides both metallic and optical fiber capability along with desired properties such as the capability of easily accessing either the metallic conductors or the optical fiber or both. The sought-after cable will fill a need in the marketplace as services to the home are expanded.

Summary of the Invention

The foregoing problems have been overcome by the hybrid cable set forth in the claims.

Brief Description of the Drawing

FIG. 1 is an end view of a hybrid communications cable;

FIG. 2 is an end view of an alternative embodiment of a hybrid cable having a circular cross-section;

FIG. 3 is an alternative embodiment in which an optical fiber duct is spaced from a metallic conductor portion;

FIG. 4 is a still further embodiment which includes an optical fiber portion and a spare duct;

FIG. 5 is an elevational view of a hybrid communication cable in which an optical fiber portion has been extended after breakout of a metallic conductor portion;

FIG. 6 is an end view of an alternative embodiment which includes a self-supporting sheath system and which is suitable for aerial use; and

FIG. 7 is an end view of an alternative embodiment which includes metallic conductors which may be used for the transmission of electrical power.

D tailed Description

Referring now to FIG. 1, there is shown a hybrid cable which is designated g nerally by the numeral 20. The cable 20 includes a first transmission portion 22 which in a pref rred embodiment may be a metallic conductor portion and a s cond transmission portion which in a pr ferred embodiment may be an optical

fiber portion 24.

The metallic conductor portion 22 includes a core 30 which includes a plurality of pairs of insulated metallic conductors 32-32. Each of the insulated metallic conductors includes a longitudinally extending metallic conductor 34 and an insulation cover 36. The insulation cover 36 may include one or more layers of insulation material such as one, for example, which is made of polyethylene. About the twisted pairs of metallic conductors is disposed a core wrap 38 which in a preferred embodiment is made of a plastic material such as polyester plastic material, for example.

It should be apparent that other materials may be used to provide the insulation covers 36-36. For example, should it be desired to extend the cable 20 onto customers' premises, the insulation cover desirably is a flame retardant material such as a polyetherimide or other non-halogenated plastic material.

The metallic conductor portion 22 of the cable 20 may also include waterblocking provisions. Disposed within interstices among the conductor pairs and between the conductor pairs and the core wrap 38 is a filling material 40 which is waterblocking. A suitable filling material 40 is one such as that disclosed and claimed in U.S. patent 4,870,117.

About the wrapped core is disposed a shielding system which may comprise one or more corrugated metallic shields. For example, the cable 20 may include a corrugated aluminum shield 42 which has been wrapped about the core to form a longitudinal gapped seam 43 and a corrugated steel shield 44 which has been wrapped about the corrugated aluminum shield and which has a longitudinal overlapped seam 46. Of course, the seams may be offset circumferentially from each other.

Lastly, for the metallic conductor portion 22, a jacket 48 which is made of a plastic material such a polyethylene encloses the shielding system. Of course, other suitable materials such as polypropylene or non-halogenated flame retardant materials may be used for the jacket 48.

The metallic conductor portion may include other waterblocking provisions. For example, a layer of a laminate which includes a superabsorbent material in powder form may be included in the sheath system. Further, yarn which has been treated with a superabsorbent material may be included in the sheath system or in the core. See, for example, U.S. patent 4,867,526 and U.S. patent 4,815,813.

As is seen in FIG. 1, the optical fiber portion 24 of the cable 20 includ s provisions for receiving optical fiber transmission media such as an optical fiber cable 50 which includes a plurality of optical fibers 51-51 (see FIG. 2). Such a cable 50 may be one such as that disclosed in U.S. pat nt 4,844,575. A longitudinally extending duct 52 is disposed outside the jacket 48 of the metallic conductor portion 22 and in a preferred embodiment is made of polyethylene. Other materials may be used for the duct 52. For example, if it is desired to extend the cable onto customers' premises, the duct may be made of a fluoropolymer or a non-halogenated material.

Instead of an optical fiber cable 50 loose optical fiber may be installed in the duct 52. In that event, the duct 52 is sized so that an inner area defined by the inner diameter of the duct is sufficiently large to maintain a suitable packing ratio of the optical fibers 51-51 which may become disposed in the duct. By packing ratio is meant the ratio of the sum of the transverse cross-sectional areas of the optical fibers to the inner area defined by the inner diameter of the duct. A suitable ratio is in the range of about 0.1 to 0.5.

Holding the metallic conductor portion 22 and the optical fiber portion 24 together is an outer jacket 60. The outer jacket 60 preferably is made of polyethylene, but for indoor uses may be a suitable flame retardant material. As is seen in FIG. 1, an outer jacket 60 engages a substantial portion of the circumference of the jacket 48 of the metallic conductor portion 22 and a portion of the duct 52.

Of course, when the cable 20 is manufactured, the cable may not include optical fiber. What it does include are provisions for receiving optical fiber at a later time as the use of optical fiber can be justified economically. At a subsequent time, optical fiber may be installed in the duct 52 by the use of a pre-placed pulling tape 61 or by using the flow of air. In the alternative, the fiber may be caused to become disposed in the duct 52 by the methods described and claimed in copending commonly assigned application Serial No. 07/720,988.

The optical fiber portion 24 also may include waterblocking provisions. For example, if optical fibers are disposed in the duct 52 either during manufacture of the cable 20 or subsequently, the duct may be filled with a waterblocking material such as that disclosed in U.S. patent 5,187,763 and which is incorporated by reference hereinto.

The cable 20 of this invention is advantageous from a number of standpoints. For example, accessing the optical fiber in the cable 20 is relatively easy; only the outer jacket 60 need be violated to reach the optical fiber portion 24. Further, because the duct 52 may be used to receive an optical fiber cable, any suitably sized cable may be used, depending on specific needs. Also, the metallic conductor portion 22 may be a standard offering multipair cable. Further, the configuration is adaptable to various size ducts and various copper conductor cabl sizes. Accordingly, the cables of this invention facilitate the marriage of optical fib r and metallic conductor cables, each having properties to meet sp cific needs.

Although the configuration of the cable in FIG. 1 is non-circular, a circular arrangement is achievable. Instead of extruding the jacket cover the duct 52 and over the metallic conductor portion 22, the duct and

the metallic conductor portions are enclosed in a circular metallic member 62 (see FIG. 2) which has been wrapped about the assembly of the duct and the metallic conductor portion. The metallic member 62 is provided with an adhesive material such as an adhesive copolymer material on its outer major surface. Then an outer jacket 64 is extruded about the circular metallic member and becomes adhered thereto.

In the embodiments shown in FIGS. 1-2, the optical fiber portion 24 is contiguous to an outer surface of the metallic conductor portion 22. In an alternative embodiment shown in FIG. 3 and designated generally by the numeral 70, the optical fiber portion 24 is spaced from the jacket 48 of the metallic conductor portion 22 but connected thereto through a web 72 of a plastic material which is the same plastic material of which the duct 52 and the outer jacket 48 are made.

A still further embodiment is depicted in FIG. 4. Therein, a hybrid cable designated generally by the number 80 includes a metallic conductor portion 22, an optical fiber portion 24 and a spare duct 82. In this embodiment, the cable 80 may include optical fibers 51-51 or an optical fiber cable 50 disposed in the duct 52 whereas the spare duct 82 provides the capability of having additional fiber added thereto in the future.

The cable of this invention provides much flexibility in satisfying customers' needs. Reels of ducts and copper cables may be maintained in inventory in cable factories. As demand arises, a particular duct size may be joined to a particular copper cable size to customize the final product. A fixed size first transmission portion need not be attached permanently to a fixed size second transmission portion until a need is determined.

Optical fiber may be caused to become positioned in the duct in the factory or in the field when the need arises. When a future installation of optical fiber is planned, the duct of the cable is supplied with a pull tape therein.

Further, there is no requirement for the final installation that the copper cable portions and the duct be coextensive in length. After the copper cable portion 22 of a cable 20 is separated from the duct, the optical fiber portion 24 may be extended or routed separately by splicing a duct extension 92 (see FIG. 5) to the duct 52 with an alignment sleeve 94.

Cables of this invention also may be used aerially. For example, as is shown in FIG. 6, the cable of FIG. 2 may be provided with an aerial support portion 96. The aerial support portion 96 includes a longitudinally extending strength memb r 97 nclosed in a plastic jacket 98. The jack t 98 is connected to the plastic jacket 64 by a web 99 of plastic material.

Also, as mentioned in the Background of th In- v ntion, a hybrid cable desirably includes metallic conductors which may b used to transmit electrical power for any number of purposes. In FIG. 7 is depicted the cable of FIG. 2 with two transmission media 100-100 which are suitable for the transmission of electrical power.

Cables of this invention are such as to be able to provide enhanced transmission capability to suit customers' needs. Further, various combinations of metallic conductor and/or optical fiber portions may be made. For example, in the configuration of FIG. 1, the first transmission portion need not be a metallic conductor portion but instead may be an optical fiber portion such as the optical fiber cable 50, for example. The second transmission portion affords the capability of enhancing the optical fiber capacity of the cable 20 at a future date as the need arises. Also, although the first transmission portion is depicted as having a larger outer diameter than that of the second transmission portion, the reverse may be true or they may be equal in size. Further, if the first transmission portion includes metallic conductors, the metallic conductors at a future date may be used for transmitting electrical power as optical fiber transmission media are added to the duct.

Claims

1. A hybrid cable, which comprises:

   a first transmission portion which comprises a sheath system which includes a plastic jacket;

   a second transmission portion which includes a duct which is made of a plastic material and which is disposed outside said jacket of said first transmission portion; and

   means disposed about said first and second transmission portions for holding together said first and second transmission portions.

2. The hybrid cable of claim 1, wherein said first transmission portion is a metallic conductor portion which includes a plurality of twisted pairs of insulated metallic conductors disposed within said sheath system and wherein said duct is adapted to receive optical fiber transmission media and wherein said means include an outer jacket.

3. The hybrid cable of claim 2, wherein said metallic conductor portion includes a core wrap comprising a strip of plastic material which has been wrapped about said plurality of twisted pairs of insulated metallic conductors.

4. The hybrid cable of claim 3, wherein said metallic conductor portion also includ s a shielding system which is disposed between said plastic jacket and said plurality of twist d pairs of insulated metallic conductors.

5. The hybrid cable of claim 2, wherein said duct and said jacket of said metallic conductor portion are spac d apart and are joined by a plastic web extending therebetween.

6. The hybrid cable of claim 1, wherein a longitudinally extending tape is disposed within said duct and is used to pull optical fiber or optical fiber cable into the duct.

7. The hybrid cable of claim 1, wherein said cable includes two ducts each of which is disposed outside said jacket of said first transmission portion and each being capable of having optical transmission media received therein, said means including an outer jacket enclosing said first transmission portion and said two ducts.

8. The hybrid cable of claim 7, which also includes a plurality of optical fibers which are disposed in one of said ducts.

9. The hybrid cable of claim 1, wherein said means includes an outer jacket, said hybrid cable also including an aerial support portion which includes a longitudinally extending strength member and a jacket which is disposed about said longitudinally extending strength member and which is connected to said outer jacket by a web which is made of plastic material.

10. The hybrid cable of claim 1, which also includes means for transmitting electrical power.

FIG. 1

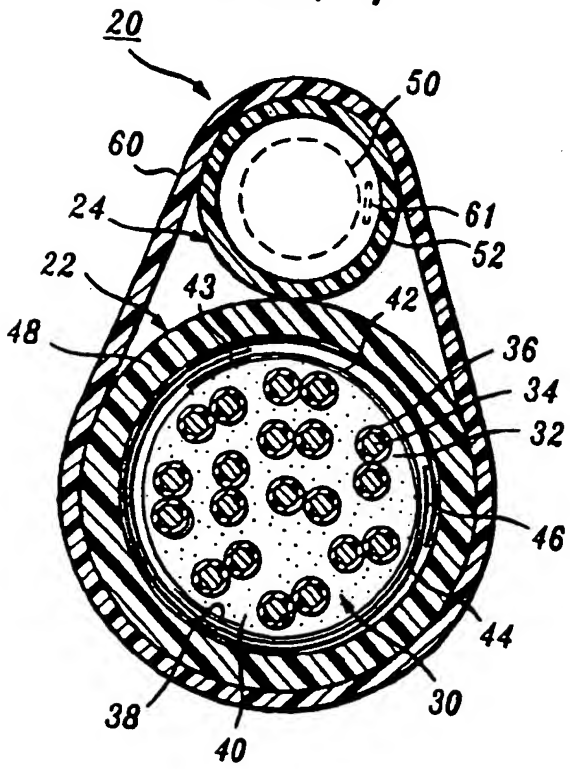

FIG. 2

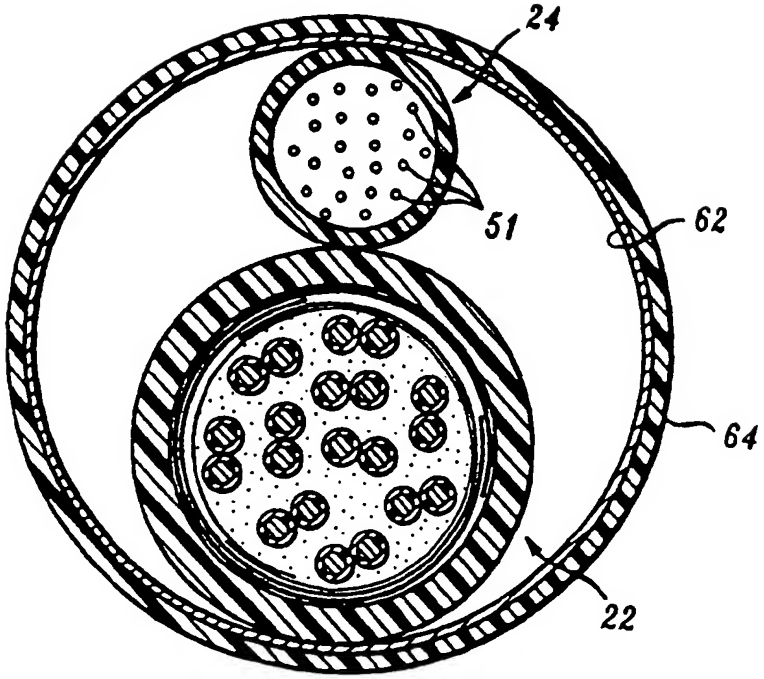

FIG. 3

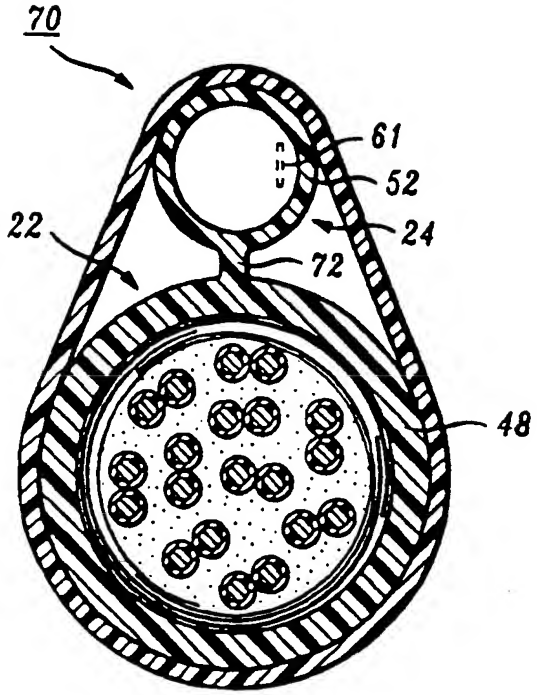

FIG. 4

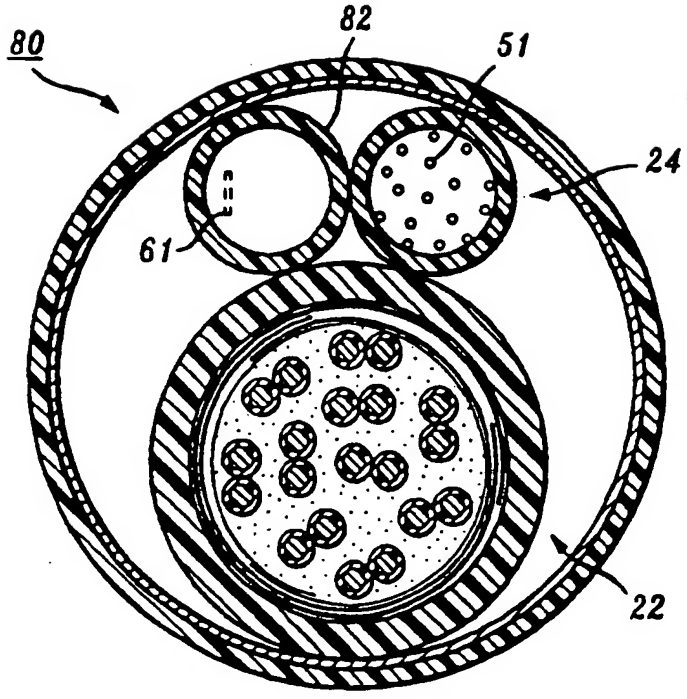

FIG. 5

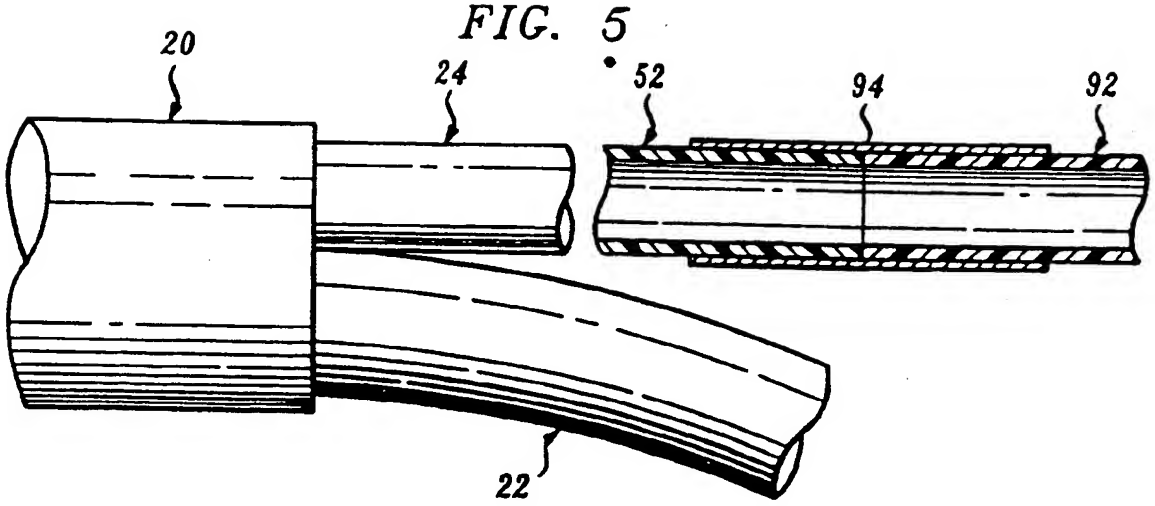

FIG. 6

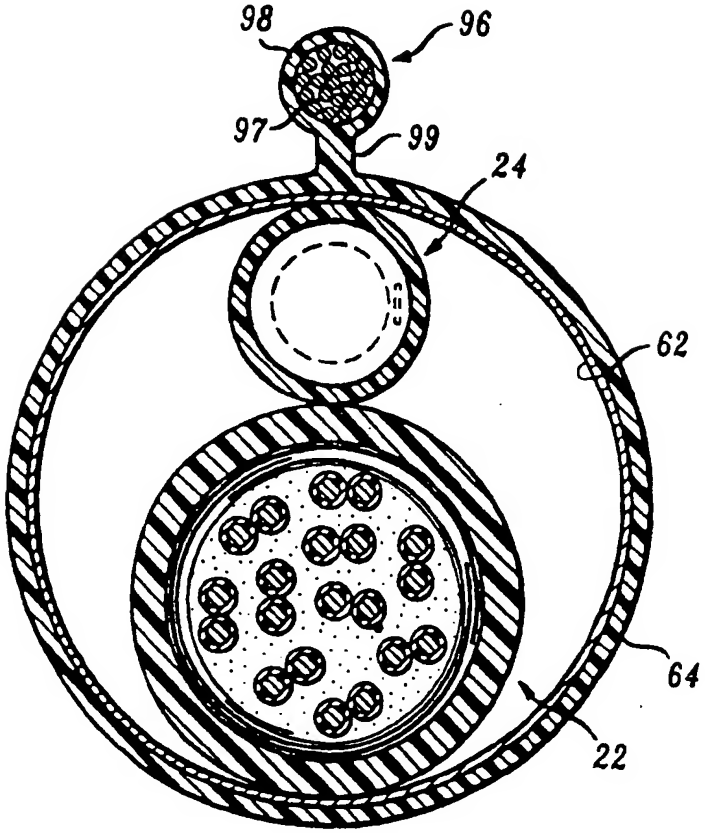

FIG. 7

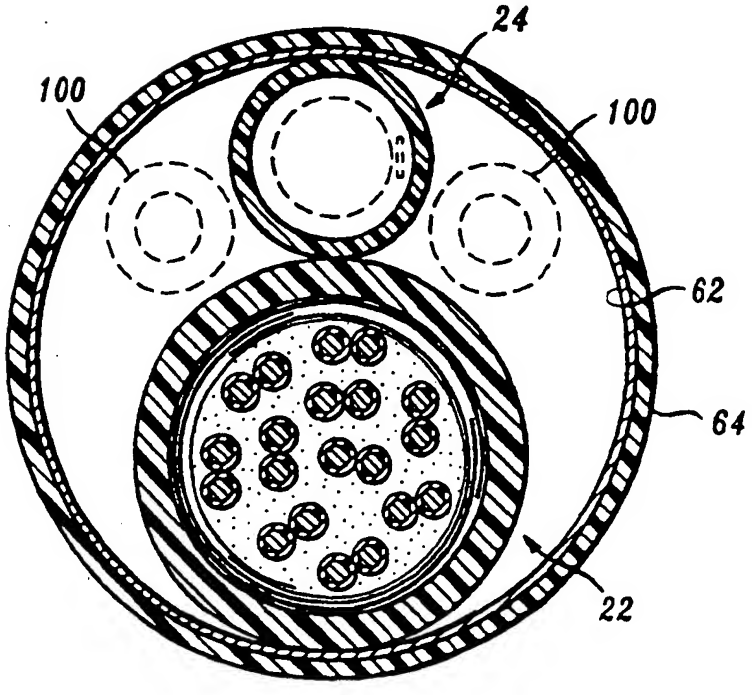

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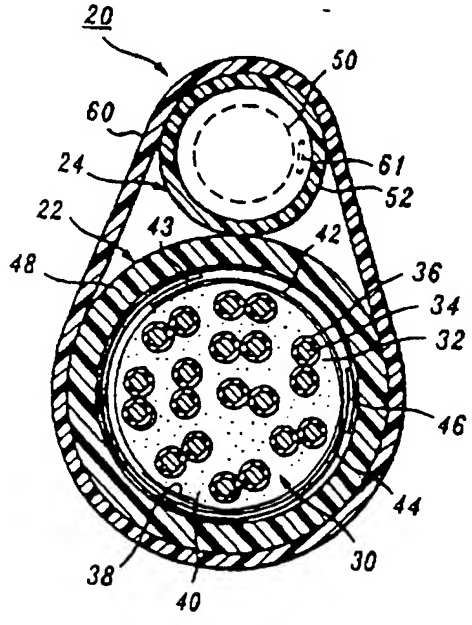
FIG. 1



EP 0 562 770 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 2073

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-2 107 896 (STANDARD TELEPHONES AND CABLES)	1	H01B11/22 G02B6/44
A	* page 1, line 49 - line 64; figure 1 *	2,9	
A	GB-A-2 168 824 (TELEPHONE CABLES) * claims 1,6,7; figure 1 *	1,2,7,9	
A	US-A-5 039 195 (JENKINS ET AL.) * column 3, line 26 - column 6, line 44; figures 1,2 *	1,2,9	
A	GB-A-2 230 106 (BICC) * page 5, line 19 - page 6, line 19; figure 2 *	1,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01B
G02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 OCTOBER 1993	DEMOLDER J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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